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ABSTRACT

This collection of materials supports the teaching of solar energy concepts in the context of secondary school science. Included in this collection are a basic teacher's guide to activities involved in the curriculum; a discussion of multi-disciplinary extensions of solar energy education by subject area; a section on hardware needed for the curriculum; and a section of resources and references. (BE)

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DOE/CS-0060

TEACHER'S GUIDE

U S DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

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SOLAR ENERGY PROJECT

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INTRODUCTION

AS OUR ENERGY NEEDS ACCELERATE AND OUR NON-RENEWABLE ENERGY SOURCES DIMINISH, WE FACE AN EVER—INCREASING NEED TO DEVELOP VIABLE ENERGY ALTERNATIVES. TO INSURE PROPER UTILIZATION OF ANY AND ALL ENERGY SOURCES, OUR TECHNOLOGICAL SOCIETY MUST BE EDUCATED SO THAT SCIENTIST AND CONSUMER WORK TOGETHER.

THE SOLAR ENERGY EDUCATION PROJECT WAS DESIGNED TO HELP MEET THIS OBJECTIVE. DEVELOPED BY SECONDARY SCHOOL SCIENCE TEACHERS, THIS PROJECT CONTAINS NUMEROUS ACTIVITIES ON THE TOPIC OF SOLAR ENERGY FOR GRADES 7-12. THE ACTIVITIES ARE DESIGNED FOR INFUSION INTO EXISTING CURRICULA. A TEACHER'S GUIDE, BIBLIOGRAPHY, AND OTHER LEARNING AIDS ARE INCLUDED.

IT IS HOPED THAT AS TEACHERS USE THESE MATERIALS THEY WILL SHARE WITH THE MEMBERS OF THE PROJECT ANY REVISIONS WHICH THEY DEVELOP.

SOLAR ENERGY IS A TIMELY TOPIC, ONE THAT HAS IMPLICATIONS FOR THE LONG—TERM FUTURE OF THE UNITED STATES. BY TEACHING OUR YOUNG PEOPLE OF ITS POTENTIAL, TEACHERS CAN BE INSTRUMENTAL IN HELPING WITH OUR NATION'S ENERGY FUTURE.

ACKNOWLEDGEMENTS

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Project Staff

Thomas Boehm, Director
Mary Pascucci, Administrative Assistant
Dale Westcott, Coordinator
Lesa Clark, Secretary

Project Advisors

Edward Lalor
Michael Radlick
Douglas Reynolds
John Favitta
Jane Dickerson

Project Instructors

Volker Mohnen
Raymond Falconer
Thomas Norton
Ronald Stewart
Donald McClenahan
Eric Allen
James Healey
Bruce Bailey
Philip Falconer

Project Artists

Frederick Haber
Anthony Costa
Marion Fluchere
Susan Rittger
Susan Walker
Keith Prior

Project Editors

Bruce Tullock
Stephen Rumsey
Thomas Atkinson
Rose Anne Fogarty
Carolyn Graham
David Heacock
Gerald Cerne
John Kwasnoski
Jane Cappiello
David Wentworth
William Legg

Project Evaluators

Reuben Rusch
Mac Carlton
Kathy Minard

Project Participants

Joseph Accongio
George Andrzejewski
Francis Angellotti
Kathryn Balmer
Barbara Baxter
Thomas Berle
John Blakes
Bryan Buchanan
Carol Burkhart
Dorothy Buzzell
Carleton Campbell, Jr.
Peter Cardamone
Alan Cederstrom
William Cheesman
Joseph Clancy
Constantine Constant
Vincent Corsall
Harry Cressman
Sister Ellen Curry
John Dadeo
Rosario Dalia
Arnold Dansky
Donald Dashnaw
Robert Dayton
Edmund DeJulio
Frederick Deussing
Robert Eustace
Kevin Fager
Mark Flamendorf
Monroe Fremed
Joanne Gallagher
Robert Gleason
Howard Gohl
Clyde Goodrich
Elwood Hacker
Thomas Hoak
Robert Hennig
William Kellerhals
James Kennedy
James Klausen
Wesley Knapp
Joan Kosinski
Gary Kosowsky
Daniel Kujawinski
Barbara Lehman
Michelle Mazon
James Mazza
William Metzler
John McGrath
Theodore Mullen
David Nilsen
Thomas O'Day
Damon Ormsby
Ronald Quinn
Sister Marion Rappl
Richard Rohrlack
Nicholas Romano
Arthur Rondeau
Mary Agnes Scanlon
Alfred Scarpinato
Alfred Schutte
Robert Shimony
Paul Siebold
Anita Silver
Reuben Silver
David Smith
Richard Springer
Arthur Stark
Leonard Stowell
Charles Sumprer
Michael Terpin
Deyo Trowbridge
Raymond Vittucci
Robert White
Steven Whitman
Kenneth Zacharias

SOLAR ENERGY CURRICULUM 7 - 12

SCOPE & SEQUENCE

The Solar Energy Curriculum is available in seven packets from the United States Department of Energy, Technical Information Center, P.O. Box 62, Oak Ridge, Tennessee, 37830. These materials include a Teacher's Guide and Support Material (1 packet), classroom activities (5 packets) and a Solar Energy Text (1 packet). The organization of the curriculum is described below.

TEACHER'S GUIDE AND SUPPORT MATERIALS (1 PACKET)

Teacher's Guide

The Teacher's Guide explains the various components of the project and their use. The following sections are included:

- The Activity Format
- Activity List with Descriptions
- Instructional Strategies:
  - Subject vs. Content Matrix
  - Topical Development Outline
- Description of Supporting Materials
- Role of Solar Energy Text
- Project Overview

Supporting Materials

The Support Materials, intended to supplement the activities, consist of the following units:

- o The Reader
- o Hardware
- o Multidisciplinary Extensions
- o References and Resources

THE ACTIVITIES (5 PACKETS)

The solar energy activities have been packaged by subject area and are numbered sequentially as indicated below.

Subject Area	Activity Number
Junior High Science	1-14
Earth Science	15-25
Biology	26-29
Chemistry & Physics	30-36
General Solar Topics	37-43

SOLAR ENERGY TEXT (1 PACKET)

Each activity contains a teacher-resource section which provides the necessary information for using the activity in the classroom. For teachers who desire a more comprehensive background in solar energy technology, however, a text is available. This text covers a broad range of topics including technical, social and economic aspects of solar energy.

TEACHER'S GUIDE

THE ACTIVITIES

The solar energy project materials have been developed by teachers for use in grades 7-12. The core of the project consists of 43 student activities, each dealing with a specific aspect of solar energy. These activities could be done as teacher demonstrations; however, it is recommended that students perform the activities themselves in order to increase interest and more effectively meet the stated objectives. The activities are arranged according to suggested grade level and/or content area in which they may be taught. Each activity consists of two parts. The first part contains directions to the student and the second part supplies supportive information to the teacher.

Student Section:

The student section provides a setting for the activity, cites the objectives and prerequisites and lists the materials needed. The materials have been deliberately kept simple, accessible, and inexpensive and, in many cases, can be built by students either during class or after school. Methods for undertaking the activity are provided, followed by by a recapitulation and questions, and finally suggestions are given for extending the activity.

Teacher Information Section:

The teacher information section provides background information, gives hints on gathering materials, suggests the approach to take, includes the appropriate grade level and discipline, and indicates the time required for completion. Typical results are given as well as precautions and possible modifications. Methods of evaluating student's performance and possible references complete the section.

(The activity packets which are listed on the following pages, TG2-6, can be ordered from the United States Department of Energy, Technical Information Center, P.O. Box 62 Oak Ridge, Tennessee, 37830, according to the following categories: Junior High; Earth Science; Biology; Chemistry & Physics; General Solar Topics.)

ACTIVITIES

Activity #	Title and Description

JUNIOR HIGH:

1 A SOLAR DESALINIZER

The separation of impurities from water through evaporation and condensation is demonstrated through the construction and use of a small solar "still."

2 COLLECTING THE SUN'S ENERGY

Using readily available materials, students construct a simple solar collector including all essential components and calculate the amount of heat energy collected.

3 ENERGY FROM THE SUN

Through comparisons of readings taken from a solarimeter and clinometer, students determine the optimal angle at which to orient a solar collector.

4 ENERGY STORAGE

Students construct and test a simple apparatus to compare the heat storage and release properties of air and rocks, and speculate on the optimal medium for a solar heating system.

5 EXPLORING BASIC PROPERTIES OF SOLAR ENERGY: ABSORPTION

Graphing the rate at which solar energy is absorbed by black soil, white sand and air and then converted into heat energy leads to an understanding of differential absorption and reflection.

6 EXPLORING BASIC PROPERTIES OF SOLAR ENERGY: REFLECTION

A pyranometer is employed by students to measure the relative degree of solar energy reflection by a number of diverse surface materials.

7 EXPLORING BASIC PROPERTIES OF SOLAR ENERGY: TRANSMISSION

A solar cell or pyranometer is employed to test the transmittance of a variety of materials which might be utilized as solar collector glazing.

8 THE HEATING AND COOLING OF OBJECTS BY RADIATION

The rates of absorption and radiation of heat energy by black and shiny cans are compared in order to draw inferences concerning the optimal solar collecting surface.

9 INSULATION: CAN IT KEEP HEAT IN AND OUT?

The abilities of several insulating materials to keep heat either in or out are measured and compared graphically. The best insulator against both heat loss and gain is then determined.

10 LET'S PUT SOLAR ENERGY TO WORK

The effects of solar energy as received by a flat plate collector on water, chocolate, and tea bags are expressed in both qualitative and quantitative terms.

11 ROOF OVERHANG

Using insulated model homes, students investigate the effect of varying the amount of roof overhang upon heating due to incident solar radiation.

12 SOLAR ENERGY IN A COFFEE CAN

A simple solar collector is constructed and used to test the efficiency of various types of glazing and insulation.

13 SOLAR WATER HEATER

Students construct a simple solar water heating system and determine several ways to make it more efficient.

14 THE EFFECT OF SURFACE COLOR ON HEAT ABSORPTION

By comparing the absorption and reflection of infrared radiation by surface of different colors, conclusions are drawn concerning the optimal solar collecting surface.

EARTH SCIENCE

15 A CUP OF SUNLIGHT

The solar heat absorbance and depth conductivity of several soil samples are related to such variables as particle size, porosity, and density.

16 THE SOLAR THERMOMETER

Students construct and calibrate a solar thermometer activitated by the expansion and contraction of air due to changes in solar radiation. The instrument is then used to measure the temperature of several environments.

17 BUILDING A SOLAR STILL

Students construct a simple survival-type solar still and collect and interpret data taken while using the still.

18 CLOUD COVER AND ITS EFFECT ON AVAILABLE INCIDENT SOLAR RADIATION

Students use a solarimeter to measure incident solar radiation over a set period of time. The effects of clouds during the measurement time are also studied.

19 DETECTING SOLAR ENERGY

Using a paddle-type radiometer, students investigate the amount of radiation incident to it.

20 SOLAR ENERGY: HOW WELL DOES IT WORK?

By comparing the temperature changes and heat added to water and air both and outside a collector, an appreciation of the potential value of solar energy "capture" is developed.

21 EARTH'S ENERGY BUDGET

The relationship between the changing patterns of solar insolation and earth surface temperatures is determined through the use of an analogous working model.

22 THE GREENHOUSE EFFECT

Using a simple apparatus, students investigate the effect (commonly called the "greenhouse effect.") of an infrared opaque glazing on the temperature of an enclosed container.

23 THE SUN'S POSITION IN THE SKY

Using a simple apparatus of their own construction, students measure the altitude and azimuth of the sun at different times of the day. Comparisons are made with published data and inferences drawn concerning daily and annual relative solar motion.

24 VARIATION OF THE SUN'S INTENSITY

Using a teacher-constructed simulator, students examine the effect of the sun's altitude on the intensity of radiation reaching the earth's surface.

25 WHAT IS SOLAR ENERGY?

Several exercises acquaint students with the types of radiant energy in the electromagnetic spectrum, their importance to man, and the relative intensities of those forms produced by the sun and transmitted to the earth.

BIOLOGY:

26 BEANLIGHT

Plant biomass energy conversion is demonstrated by students as they grow, dry, and burn bean plants. Calorimeters are used to measure the heat released.

27 BIOMASS: STORED SOLAR ENERGY

Using the traditional definition of a cord of firewood, students calculate the volume of the firewood and the amount of heat that can be realized from burning various kinds of woods.

28 FUELS FROM SOLAR ENERGY AND WASTES

Students explore the use of solar energy to produce fuels from wastes through application of solar concentrating lenses to simple pyrolytic converters.

29 YOUR PLACE IN THE SUN

Using calculations of family energy needs, students compute the amount of land that could provide that amount of energy from biomass conversions.

CHEMISTRY & PHYSICS

30 A COMPARISON OF ABSORBER PLATE COATINGS

Students prepare absorber plates with several different coatings and monitor and compare the temperature increases of the plates while exposed to the sun's radiation.

31 CONSTRUCTION OF A FLAT PLATE AIR FLOW SOLAR COLLECTOR

Students construct a model air flow solar collector and through experimentation determine the relative importance of various collector components to collector operation.

32 HOW MANY LIGHT BULBS = THE SUN'S ENERGY?

A simple solar collector, a 100-watt bulb and the inverse square law are employed by students to ascertain the sun's total energy production in watts and compare this to the energy output of 100-watt light bulbs.

33 MEASURING ENERGY FROM THE SUN

Using a simple solarimter, students measure the variations in the intensity of solar energy falling on a surface held at several angles of incidence.

34 MEASURING THE HEAT OF A SOLAR COLLECTOR USING A THERMOCOUPLE

Thermocouples are constructed and used to measure the increasing temperatures of a simple flat plate collector.

35 SOLAR ENERGY AND THE HEAT OF HYDRATION

The heats of hydration of hydrated salts may be an important factor in future storage of solar energy. Students quantitatively compare the relative efficiency and economy of two such salts.

36 SUNLIGHT AND SURFACE HEATING EFFECTS

The effects of time, height, and surface materials upon air temperatures produced by surface heating are determined from an analysis of observations in chart and graphic forms.

GENERAL SOLAR TOPICS:

37 A PASSIVE SOLAR ENERGY HOUSE

Students are asked to design, orient, and landscape a model house to maximize the use of the sun for passive heating and minimize infiltration losses.

38 CAREERS IN SOLAR ENERGY

Students use library and guidance resources to explore the opportunities and requirements for employment in solar energy occupations and related fields.

39 EFFECTS OF INSULATION ON HOME HEATING COSTS

Students determine the annual heat losses of a typical house with different amounts of wall and ceiling insulation. They also calculate the yearly fuel costs for the varying insulation combinations and graph the results.

40 HOME ENERGY USE

Through the collection of home electrical and fuel use data placed in daily and weekly journals, students compute and compare consumption rates for several energy sources and examine ways to conserve energy in the home.

41 SOLAR ENERGY IN A MAGAZINE

Students become acquainted with the use of library resources to discover journal articles pertaining to solar energy, several of which are read and annotated.

42 TRACKING THE SUN BY COMPUTER

Using a computer simulation, students find the location of the sun by altitude and azimuth as well as right ascension and declination. A computer capable of accepting BASIC computer language is required.

43 PUZZLES

The spelling and definitions of solar energy terms can be reviewed and enhanced by several short and motivating exercises, including word searches, word completions, and crossword puzzles.

CONTENT-GRADE LEVEL MATRIX

The matrix identifies the adaptability of activities to more than one course of study and the broad range of uses to which the activities can be put in the development of topics or units. (Activity 12, for example, "Solar Energy in a Coffee Can," is included in the Junior High Science activity packet but can be effectively used in either an earth science course or a physics class.)

SUBJECT vs. CONTENT MATRIX	THE SUN			SOLAR ENERGY				USES OF SOLAR ENERGY						ENERGY CONSERVATION	GENERAL
	POSITION	MEASUREMENT OF RADIATION	VARIATION OF RADIATION	TRANSMITTANCE	REFLECTION	ABSORPTION	CONDUCTION	PASSIVE HEATING	ACTIVE HEATING - COLLECTION	ACTIVE HEATING - STORAGE	BIOMASS CONVERSION	PYROLYSIS	WATER PURIFICATION AND DESALINIZATION		
JUNIOR HIGH SCIENCE 7-9	23	16 19 25 33	24 18	7	6 14	5 8 14		11 22	2 3 10 12 13 20 31 34	4	26	28	1 17	9	
EARTH SCIENCE	42	16 19 25 32 33	18 21 24	7	6	5 15	15 36	22	2 12 20 31				1 17	39 40	
BIOLOGY											26 27 29	28	1 17	39	
PHYSICS & CHEMISTRY		25 32 33				8 15	15 36		2 12 31 34	35	26 27		1	9 39 40	
SCIENCE 7-12						15	15 36	37	30		29			40	38 41 43

TOPICAL DEVELOPMENT OUTLINE

The solar energy activities may be grouped in a number of ways to emphasize a topic. The topical outline provides a list of topics that will assist in selecting solar energy activities related to specific topics or areas of study.

TOPIC		ACTIVITY
Properties of Solar Energy	5	Exploring Basic Properties of Solar Energy: Absorption
	6	Exploring Basic Properties of Solar Energy: Reflection
	7	Exploring Basic Properties of Solar Energy: Transmission
Solar Absorption	5	Exploring Basic Properties of Solar Energy: Absorption
	8	The Heating and Cooling of Objects by Radiation
	14	The Effect of Surface Color on Heat Absorption
	15	A Cup of Sunlight
Measuring Solar Energy	16	A Solar Thermometer
	19	Detecting Solar Energy
	25	What Is Solar Energy?
	32	How Many Light Bulbs = The Sun's Energy?
	33	Measuring Energy From the Sun
Passive Heating	11	Roof Overhang
	22	The Greenhouse Effect
	37	A Passive Solar Energy House
Radiational Flux	18	Cloud Cover and Its Effect on Available Incident Solar Radiation
	21	Earth's Energy Budget
	24	Variation of the Sun's Intensity
	33	Measuring Energy From the Sun
Biomass Conversion	26	Beanlight
	27	Biomass: Stored Solar Energy
	29	Your Place in the Sun
Water Purification	1	A Solar Desalinizer
	17	Building a Solar Still
Solar Heat Conduction	15	A Cup of Sunlight
	36	Sunlight and Surface Heating Effects

TOPIC		ACTIVITY
Energy Conservation	9	Insulation: Can It Keep Heat In and Out?
	39	Effects of Insulation on Home Heating Costs
	40	Home Energy Use
Solar Collector Construction	2	Collecting the Sun's Energy
	12	Solar Energy in a Coffee Can
	13	Solar Water Heater
	31	Construction of a Flat Plate Air Flow Solar Collector
Solar Collector Testing	10	Let's Put Solar Energy to Work
	20	Solar Energy: How Well Does it Work?
	34	Measuring the Heat of a Solar Collector Using a Thermocouple
Heat Storage	4	Energy Storage
	35	Solar Energy and the Heat of Hydration
Solar Position	23	The Sun's Position in the Sky
	42	Tracking the Sun by Computer
Angle of Incidence	3	Energy From the Sun
	23	The Sun's Position in the Sky
	33	Measuring Energy From the Sun
Solar Collector Glazing	2	Collecting the Sun's Energy
	7	Exploring Basic Properties of Solar Energy: Transmission
	12	Solar Energy in a Coffee Can
	22	The Greenhouse Effect
Absorber Plate Surfaces	2	Collecting the Sun's Energy
	8	The Heating and Cooling of Objects by Radiation
	14	The Effect of Surface Color on Heat Absorption
	30	A Comparison of Absorber Plate Coatings
Using a Solarimeter	3	Energy From the Sun
	6	Exploring Basic Properties of Solar Energy: Reflection
	7	Exploring Basic Properties of Solar Energy: Transmission
	18	Cloud Cover and its Effect on Available Incident Solar Radiation
	33	Measuring Energy from the Sun
Skills: Reference	23	The Sun's Position in the Sky
	25	What is Solar Energy?
	38	Careers in Solar Energy
	41	Solar Energy in a Magazine
Skills: Computation	26	Beanlight
	27	Biomass: Stored Solar Energy
	29	Your Place in the Sun
	32	How Many Light Bulbs = The Sun's Energy?
	35	Solar Energy and the Heat of Hydration
	39	Effects of Insulation on Home Heating Costs
	40	Home Energy Use

SUPPORTING MATERIALS

The solar energy activities comprise the major portion of the solar energy curriculum document. However, many supporting materials have been developed to assist the teacher in providing a complete learning package. The following sections are included in the supporting materials: Reader, Hardware, Multidisciplinary Extensions, and References & Resources.

Reader:

The reader consists of twenty-one articles taken from a variety of magazines and journals dealing with various aspects of solar energy. Each article provides information on a specific topic related to those found in the activities. Many of the articles will be of interest to teachers and some will have relevance for students as well. The text plus the reader will give a person a rather complete overview of the solar energy field as it exists today.

Hardware:

The hardware section contains a limited number of plans on how to build some simple pieces of solar energy equipment. Some are taken directly from the activities and others are not. The equipment included could be used as a project for students who like to build things or as a part of an activity devised by a teacher for classroom use. Some of the ideas could lead to a long-term investigation of some aspect of solar energy. (An example is the window sun dial. It can yield data on daily, monthly, and annual motions of the sun if data is collected over several months' time. The construction is very simple but the data, and ultimately the data analysis yield very important information on the utilization of solar energy.)

Extensions:

The study of solar energy can properly be undertaken in many settings other than the science classroom. Solar energy is truly a multidisciplinary topic. The extensions section outlines possibilities for infusing the study of solar energy into a variety of courses of study. The ideas are not developed into total learning experiences but are merely suggested, leaving it to the teacher to complete the infusion. Many possibilities exist, such as using these ideas for a team teaching approach to give students a total overview of the solar energy field.

References & Resources:

Any complete teaching unit must include sources of information and references to useful readings. This section includes lists of places that provide information on various aspects of solar energy as well as references to books and magazines concerned with solar energy.

SOLAR ENERGY TEXT

The Text is a series of twenty sections that deal with various topics developed in the solar energy activities. Each section is written with some technical depth so that science teachers from all levels might find it useful. Taken as a whole, the text provides a framework for a short course in solar energy. Although written for teachers, the text may be useful for advanced students who have a mastery of simple algebra.

(The Solar Energy Text is optional and can be ordered from the United States Department of Energy, Technical Information Center, P.O. Box 62, Oak Ridge, Tennessee, 37830.)

PROJECT OVERVIEW

The curriculum project provides a variety of resource material for instruction in solar energy. It is assumed that few schools will be able to start new courses for this purpose. Therefore, the materials have been designed for use in existing courses. Very few totally new ideas are included in the study of solar energy. In many cases, just a change in emphasis can relate a traditional topic to current uses of solar energy. Since many courses of study already use the entire year to complete, the inclusion of solar energy emphasis may encourage students to study what they would have had to learn anyway.

Most experts agree that alternative energy sources will be increasingly utilized in the near future and beyond. One way to ensure an informed citizenry is to educate our school-age youngsters concerning the scientific and social consequences of employing such alternatives. The Solar Energy Education curriculum is designed to help in the furtherance of this goal.

Extensions

SOLAR ENERGY PROJECT

DRAFT

MULTI-DISCIPLINARY EXTENSIONS

THE SUN, OUR ULTIMATE ENERGY SOURCE, HAS INFLUENCED NUMEROUS CULTURES THROUGH THE CENTURIES. UNDERSTANDING ITS PHYSICAL BEHAVIOR IN SPACE HAS CHALLENGED THE TALENTS OF MATHEMATICIANS AND SCIENTISTS THROUGHOUT THE WORLD. POETS, STORY-TELLERS, AND AUTHORS HAVE TIME AND AGAIN USED THE SUN SYMBOLICALLY TO CONVEY THEIR THOUGHTS AND FEELINGS. ARTISTS HAVE DEPENDED UPON THE STAR NOT ONLY AS A SUBJECT IN ITSELF BUT MORE IMPORTANTLY AS A LIGHT SOURCE TO INTERACT WITH THEIR EXPRESSIONS OF FORM, COLOR, AND TEXTURE. THE SUN'S UNIQUE ABILITY TO PROMOTE PLANT GROWTH HAS NOT ONLY FOSTERED THE RISE OF AGRARIAN SOCIETIES BUT LONG AGO FORMED THE FOSSIL FUELS WHICH NOW SUPPORT MODERN INDUSTRIAL ECONOMIES. THE PRESENTLY DIMINISHING SUPPLY OF THESE FUELS IS NOW INTERESTING TECHNOLOGISTS IN THE PROMISE OF MORE DIRECT SOLAR ENERGY CONVERSIONS. SUCH A TRANSITION WILL BRING A HOST OF LAWYERS, POLITICIANS, ECONOMISTS, AND EVEN SOCIAL SCIENTISTS INTO THE DECISION-MAKING PROCESS. THE PERVASIVE EFFECT OF THE SUN UPON SO MANY AREAS OF COMTEMPORARY LIVING MAKES IMPERATIVE ITS STUDY WITHIN SEVERAL DIFFERENT CONTEXTS.

THE ACTIVITIES WITHIN THIS SECTION SUGGEST WAYS TO APPLY THE CONCEPTS, METHODS, AND MATERIALS OF MANY CURRICULAR FIELDS TO THE STUDY OF SOLAR ENERGY. MAJOR SUBJECT AREAS ARE PLACED ALPHABETICALLY. EACH SUGGESTION WITHIN AN AREA INCLUDES IN PARENTHESES, A KEY WORD(S) THAT FURTHER DEFINES THE TOPICAL APPLICATION, APPROPRIATE GRADE LEVELS FOR EMPHASIS, AND THE INSTRUCTIONAL MODE BEST SUITED TO THE ACTIVITY:

(KEY WORD(S)/GRADE LEVELS/MODE)

IT IS ADVISED THAT FLEXIBILITY BE USED IN THE DEVELOPMENT OF THESE EXTENSIONS. THEY MIGHT BE USED IN SPECIFIC CLASSES BY INDIVIDUAL TEACHERS OR SHARED WITH COLLEAGUES IN A MULTI-DISCIPLINARY TEAM APPROACH. IT WILL BE NOTED THAT THE EXTENSIONS GENERALLY REQUIRE HIGH LEVELS OF STUDENT PARTICIPATION. THEREFORE, THE ACTIVITIES ARE EXPRESSED IN TERMS OF WHAT STUDENTS MIGHT BE EXPECTED TO DO.

AGRICULTURE

CONSTRUCT A SMALL GREENHOUSE ON SCHOOL PROPERTY, COMPLETE WITH INDOOR AND OUTDOOR THERMOMETERS.

(HORTICULTURE/11-12/CLASS PROJECT)

CLASSIFY TREES AND FLOWERS ACCORDING TO THEIR RELATIVE SHADE AND SUNLIGHT REQUIREMENTS.

(FLORICULTURE/10-12/LIBRARY RESEARCH)

INVESTIGATE THE RELATIONSHIP BETWEEN THE SIZE OF THE LEAF AND ITS POSITION ON THE TREE FOR SEVERAL SPECIES. CLARIFY THE FINDINGS IN TERMS OF SOLAR ENERGY.

(BOTANY/10-12/HOME ASSIGNMENT

RESEARCH THE EXTENT TO WHICH FOOD PROCESSING TECHNIQUES RELY UPON THE SUN FOR DEHYDRATION OF FOODSTUFFS.

(FOOD SCIENCE/9-12/LIBRARY RESEARCH)

MAKE A CHART THAT COMPARES THE GROWING SEASONS OF VARIOUS FRUITS AND VEGETABLES AND RELATE THESE TO PHOTO-PERIODS PREVALENT.

(HORTICULTURE/9-10/PROJECT

GIVE ORAL REPORTS ON THE FOLLOWING ASPECTS OF BIOMASS ENERGY CONVERSION: PRESENT AND FUTURE TECHNOLOGIES, OPTIMAL PLANT MATERIALS, EXPERIMENTATION UNDER WAY, PRODUCTIVE LIMITS, AND CONTEMPORARY COMMERCIAL OPERATIONS.

BIOMASS/11-12/ORAL REPORTS)

FINE ARTS

VISIT AN ART MUSEUM TO OBSERVE HOW ANCIENT ART INCLUDES OR EXCLUDES THE INFLUENCE OF THE SUN.

(ANTIQUITY/9-12/FIELD TRIP)

EXPLORE AND REPLICATE METHODS BY WHICH THE SUN WAS EMPLOYED TO CREATE EARLY POTTERY.

(ANTIQUITY/9-12/PROJECTS)

TRACE THE HISTORY OF THE SUN IN ART THROUGH THE CENTURIES.

(ART HISTORY/9-12/LIBRARY RESEARCH)

RESEARCH AND PERFORM DANCES AND RITUALS THAT MYTHOLOGIZE THE SUN.

(DANCE/7-12/GROUP PROJECT)

MAKE MOBILES, COLLAGES, OR POSTERS WITH THE SUN AS THE THEME.

(GRAPHICS/7-9/PROJECTS)

INTERVIEW A MUSEUM ART CURATOR CONCERNING HOW PAINTINGS ARE PLACED IN A BUILDING TO HEIGHTEN THE EFFECTS OF SUNLIGHT.

(PAINTING/11-12/INTERVIEW)

PERFORM A PLAY WHICH USES THE SUN METAPHORICALLY OR AS AN ELEMENT IN SET DESIGN.

(DRAMA/7-12/GROUP PROJECT)

PERFORM VOCALS OR INSTRUMENTALS WHICH ALLUDE TO THE SUN.

(MUSIC/7-12/GROUP PROJECT)

HEALTH

RESEARCH AND REPORT ON THE FOLLOWING QUESTIONS: HOW MUCH SUN IS SAFE IN SUNBATHING? WHAT CAUSES SUNTANS? WHY DO SOME PEOPLE BURN AND OTHERS TAN? WHAT ARE THE DANGERS OF QUICK TANNING LOTIONS?

(DERMATOLOGY/10-12/ORAL REPORTS)

DISCUSS SUN LAMPS, INCLUDING DANGERS IN THEIR USE, DISEASES CAUSED BY OVERUSE AND CONDITIONS CURED BY THE LAMPS.

(DERMATOLOGY/10-12/LECTURE)

DESCRIBE THE SYMPTOMS OF HEAT EXHAUSTION AND APPROPRIATE TREATMENTS.

(METABOLISM/7-9/LIBRARY RESEARCH)

DETERMINE HOW SUNLIGHT PROMOTES THE PRODUCTION OF VITAMIN D AND INFLUENCES OTHER VITAMINS.

(NUTRITION/9-10/LIBRARY RESEARCH)

EXPLORE THE EFFECTS OF PROLONGED AND UNSEASONAL USE OF SUNGLASSES UPON THE INTERNAL STRUCTURE OF THE EYES.

(OPTHAMOLOGY/10-12/LIBRARY RESEARCH)

EXPERIMENT TO DETERMINE THE EFFECTS OF DIFFERENT PHOTOPERIODS UPON THE BEHAVIOR AND PHYSIOLOGY OF HUMAN BEINGS.

(METABOLISM/10-12/EXPERIMENTATION)

HOME ECONOMICS

DESIGN HOME INTERIORS THAT MAXIMIZE THE EFFICIENT USE OF SOLAR ENERGY. INCLUDE ROOM ORIENTATION, FURNITURE ARRANGEMENT, AND USE OF FABRICS IN DRAPES AND CARPETING.

(INTERIOR DECORATION/11-12/PROJECT)

PREPARE A PICNIC LUNCH THAT CAN BE COOKED WITH A SOLAR COOKER AND BAKED IN A SOLAR OVEN.

(FOOD PREPARATION/7-12/GROUP PROJECT)

CALCULATE THE PAY-BACK PERIODS FOR HOME SOLAR ENERGY INSTALLATIONS OF VARIOUS SIZES AT SEVERAL DIFFERENT U.S. CITIES.

(BUDGETING/10-12/HOME ASSIGNMENT)

DEVELOP LISTS OF CLIMATIC FACTORS TO BE CONSIDERED IN THE SELECTION OF A HOME OR APARTMENT.

(REAL ESTATE/11-12/LIBRARY RESEARCH)

INSPECT THE ORIENTATION OF CLOTHESLINES AT HOME TO DETERMINE IF THEY MAXIMIZE THE INTENSITY OF THE SUN.

(CLOTHING/7-8/HOME ASSIGNMENT)

DETERMINE THE OPTIMAL LOCATIONS WITHIN A HOME FOR GROWING PLANTS.

(INTERIOR DECORATION/10-12/ HOME ASSIGNMENT)

INVESTIGATE THE EFFECTS OF SUNLIGHT UPON FABRIC DYES TO ASCERTAIN WHICH BEST HOLD THEIR COLOR AGAINST FADING.

(TEXTILES/9-12/PROJECT

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INDUSTRIAL ARTS

CREATE A SCALE MODEL OF A CAR POWERED BY SOLAR BATTERIES.

(AUTOMOTIVE/7-9/PROJECT)

DESIGN AND CONSTRUCT A SOLAR OVEN.

(METALWORK/9-12/PROJECT)

DESIGN, CONSTRUCT, AND TEST SOLAR COLLECTORS FOR SPACE AND HOT WATER HEATING. THE FOLLOWING FACILITIES MIGHT BE USED FOR ELEMENTS OF THE EQUIPMENT:

Absorber plate construction - Metal Shop
Glazing materials - Plastics Shop
Collector Construction - Wood Shop
Thermocouples circuitry and wiring of blower motors - Electricity Shop
Design and drafting of solar collectors - Mechanical Drawing

(GENERAL CRAFTS/9-12/GROUP PROJECTS)

DESIGN HOMES WHICH FOSTER EITHER PASSIVE OR ACTIVE SOLAR HEATING.

(MECHANICAL DRAWING/10-12/PROJECT)

CONSTRUCT A SOLAR CELL ARRAY SUFFICIENT TO POWER SMALL ELECTRICAL APPLIANCES.

(ELECTRICAL SHOP/11-12/PROJECT)

LANGUAGE ARTS

WRITE POEMS THAT USE THE SUN AS A SYMBOL OR METAPHOR.

(POETRY/7-12/HOME ASSIGNMENT)

DISCOVER REPRESENTATIVE PIECES OF LITERATURE CONCERNING THE SUN FROM DIFFERENT CULTURES SUCH AS ROMAN, GREEK, FRENCH (SUN KING), AND INDIAN CULTURES. SEE IF A COMMON THREAD CAN BE FOUND.

(PROSE/11-12/LIBRARY RESEARCH)

DEVELOP A VOCABULARY LIST OF WORDS ASSOCIATED WITH SOLAR ENERGY.

(SPELLING/7-12/CLASSWORK)

USE SOLAR ENERGY CONCEPTS AS TOPICS TO ACQUAINT STUDENTS WITH LIBRARY REFERENCE SKILLS.

(INFORMATION RETRIEVAL/7-12/ LIBRARY RESEARCH)

INVESTIGATE AND DISCUSS MYTHOLOGIES OF CERTAIN CULTURES WHICH ARE BASED UPON OR INVOLVE THE SUN.

(MYTHOLOGY/7-12/DISCUSSION)

CONTRAST THE WORDS FOR SUN AMONG THE ROMANCE LANGUAGES, LOOKING FOR GENERIC ROOTS.

(FOREIGN LANGUAGES/9-12/ ASSIGNMENT)

WRITE SHORT STORIES OF SCIENCE FICTION INVOLVING THE EFFECTS UPON LIFE AS A RESULT OF SEVERE CHANGES IN SOLAR ENERGY PRODUCTION.

(PROSE/7-12/ASSIGNMENT)

PUBLISH A NEWSPAPER DEVOTED TO INFORMING THE REST OF THE SCHOOL ABOUT THE STATUS AND PROMISE OF SOLAR ENERGY.

(JOURNALISM/10-12/CLASS PROJECT)

MATHEMATICS

MEASURE THE SUN'S ANGLE WITH A HOMEMADE ASTROLABE AND USE THIS VALUE IN DETERMINING ONE'S LATITUDE.

(TRIGONOMETRY/11-12/LABORATORY)

CALCULATE THE SUN'S VOLUME FROM ITS DIAMETER.

(SOLID GEOMETRY/12/ASSIGNMENT

DETERMINE THE AREA OF SOLAR COLLECTION SURFACE NECESSARY TO GENERATE A GIVEN NUMBER OF BTU'S OF HEAT ENERGY OR KILOWATTS OF ELECTRICAL ENERGY.

(MATHEMATICS/7-8/ASSIGNMENT)

PREPARE A LINE GRAPH ILLUSTRATING THE CHANGE IN AIR TEMPERATURE WITH THE ELEVATION OF THE SUN OVER THE HORIZON.

(GRAPHING/7-8/CLASSWORK)

PREPARE BAR GRAPHS DISPLAYING THE INCREASE IN SOLAR ENERGY HEATING UNITS FOUND IN RESIDENTIAL AND COMMERCIAL BUILDINGS OVER THE PAST FIVE YEARS.

(GRAPHING/7-8/CLASSWORK)

CALCULATE SURFACE AREA TO VOLUME RATIOS OF SEVERAL BUILDINGS AND INFER THEIR RELATIVE COOLING AND HEATING NEEDS.

(PLANE & SOLID GEOMETRY/10-12/PROJECT)

SOCIAL STUDIES

PREPARE MAPS DISPLAYING RELATIONSHIPS AMONG POPULATION DENSITY, VEGETATIVE GROWTH, AND INTENSITY OF SOLAR INSOLATION.

(GEOGRAPHY/9-10/GROUP PROJECT)

INVESTIGATE THE WAYS THE SUN HAS BEEN DEPLOYED BY MILITARY STRATEGISTS IN HISTORICAL BATTLES.

(HISTORY/9-12/LIBRARY RESEARCH)

EXPLORE THE RELATIVE ALLOCATIONS OF THE U. S. DEPARTMENT OF ENERGY TO RESEARCH AND DEVELOPMENT OF MAJOR ENERGY SOURCES. DEBATE THE PROS AND CONS OF THE PRESENT LEVEL OF SOLAR ENERGY ECONOMIC SUPPORT.

(POLITICAL POLICY/11-12 DEBATE)

INTERVIEW A STATE CONGRESSMAN INVOLVED IN PROMOTING SOLAR ENERGY LEGISLATION.

(LAW/11-12/INTERVIEW)

HOLD A MOCK TRIAL IN WHICH THE DEFENDANT'S WINDMILL IS SHADING A SOLAR COLLECTOR OF A PLAINTIFF.

(LAW/11-12/DEBATE)

CONTRAST STATE SOLAR ENERGY LEGISLATION.

(LAW/11-12/ORAL REPORTS)

FOLLOWING APPROPRIATE READINGS, DISCUSS THE FOLLOWING: SUN RIGHTS, SOLAR TAX INCENTIVES, AND GOVERNMENTAL REGULATION.

(LAW/11-12/CLASS DISCUSSION)

CREATE A SOLAR ENERGY BILL OF RIGHTS.

(GOVERNMENT/7-8/CLASS PROJECT)

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Hardware

SOLAR ENERGY PROJECT

DRAFT

HARDWARE

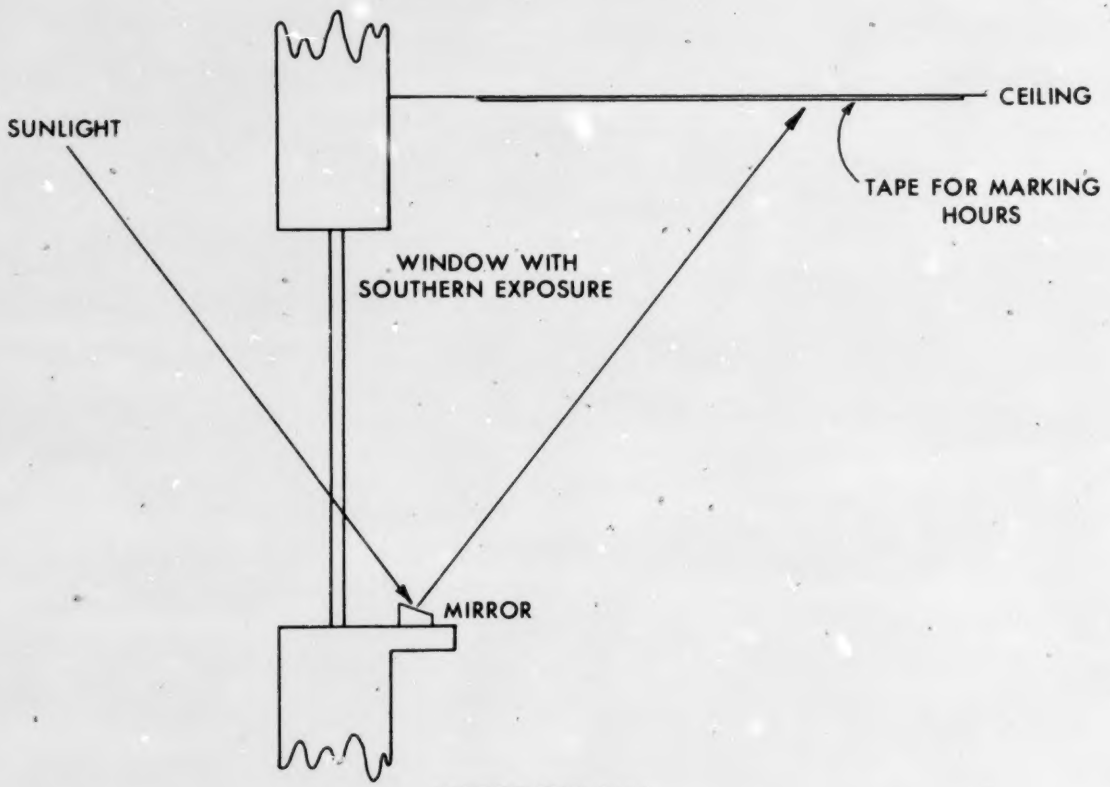
ALTHOUGH COMMERCIAL SOLAR ENERGY EQUIPMENT CAN OFTEN BE EXPENSIVE, MANY INEXPENSIVE PIECES OF APPARATUS CAN BE CONSTRUCTED USING READILY AVAILABLE MATERIALS WHICH WILL SERVE THE NEEDS OF THE CLASSROOM QUITE WELL.

THE DIAGRAMS AND DESCRIPTIONS THAT FOLLOW REPRESENT A VARIETY OF INSTRUMENTS THAT MEASURE, CONCENTRATE OR CONVERT SOLAR RADIATION. THEY ARE FAIRLY EASY TO CONSTRUCT AND PROVIDE CONSISTENT AND RELIABLE RESULTS TO USERS.

A BRIEF INTRODUCTION PROVIDES THE CONTEXT FOR EMPLOYING EACH INSTRUMENT. PROCEDURES FOR CONSTRUCTION AND USE ARE INCLUDED AS NECESSARY.

INDOOR SUN DIAL

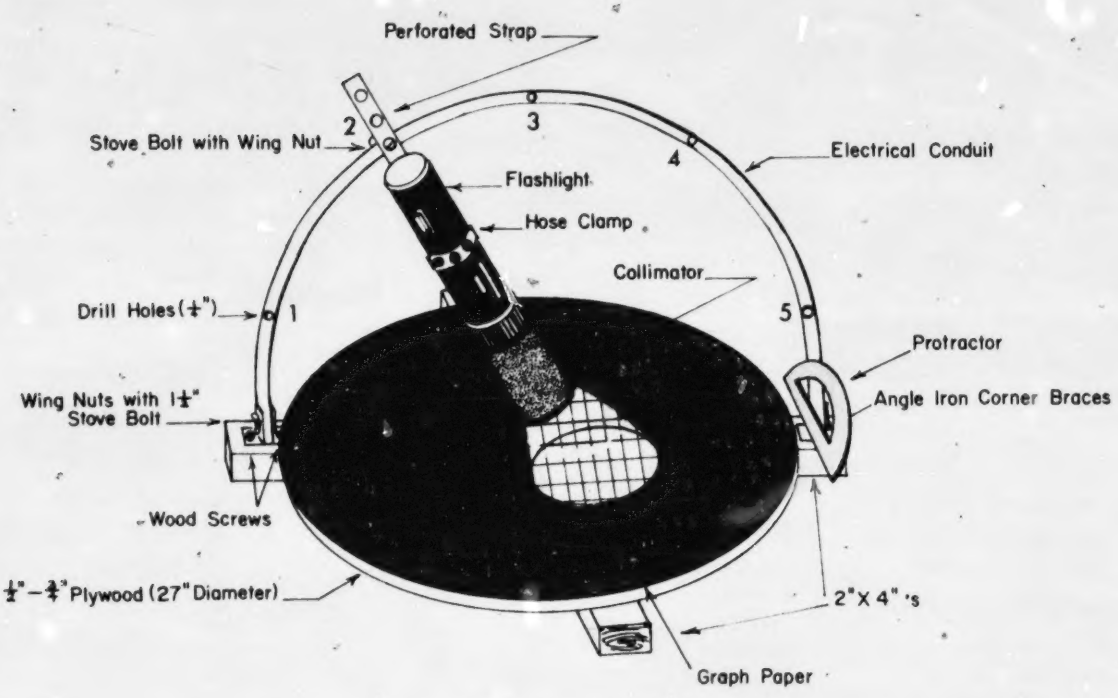
MOST SUN DIALS RELY UPON THE CHANGING POSITION OF THE SOLAR SHADOW. THIS UNIQUE APPLICATION, HOWEVER, USES A MIRROR TO DEFLECT THE SOLAR BEAM TO A SURFACE FOR CALIBRATION. WHAT RESULTS IS A FAIRLY ACCURATE TIMING DEVICE.



INDOOR SUN DIAL

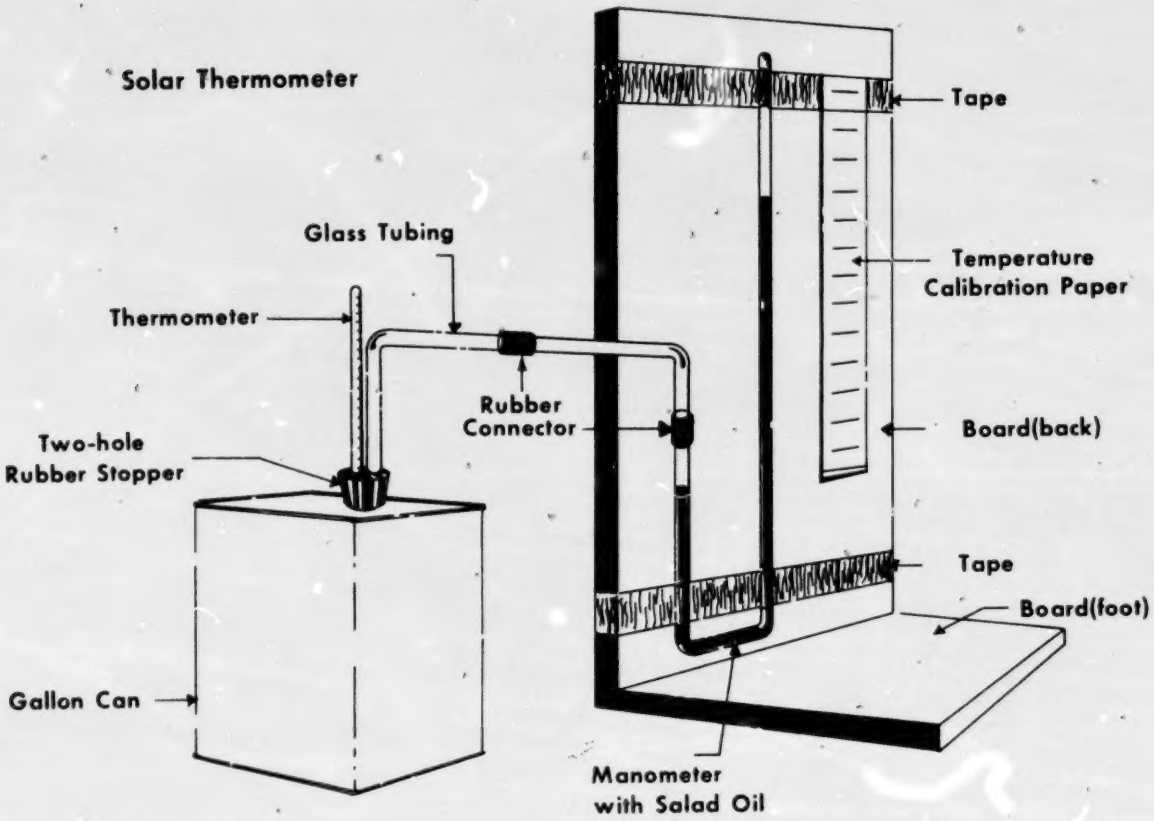
INSOL-ANGLE-METER

THE INTENSITY OF SOLAR RADIATION UPON A UNIT AREA OF SURFACE DEPENDS GREATLY UPON THE POSITION OF THE SUN IN THE SKY AND THE ORIENTATION OF THE EARTH'S SURFACE TO THE SOLAR BEAM. THIS INSTRUMENT CLEARLY REPRESENT SUCH RELATIONSHIPS IN A QUANTITATIVE FASHION.



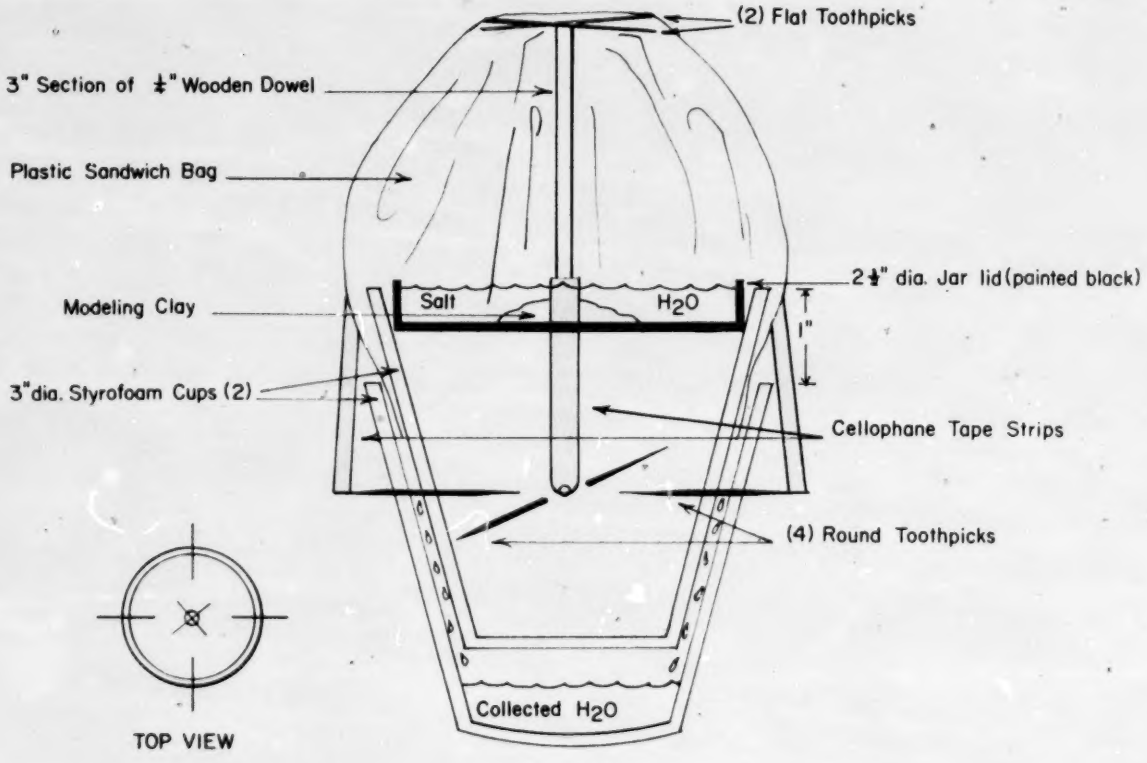
Solar Thermometer

It has long been known that gases expand their volumes with increasing temperatures (Charles' Law). This principle has been employed in the design of a thermometer based upon the expansion and contraction of air.



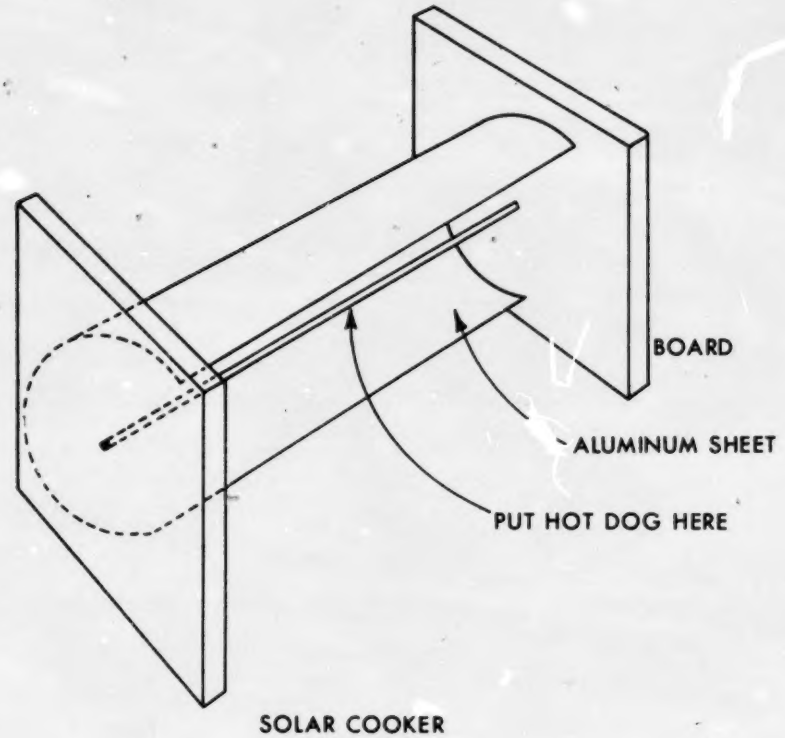
Solar Still

Applying an understanding of the latent heat of vaporization could spell survival in certain circumstances. The processes of evaporation and condensation are illustrated in the operation of this simple apparatus. Its potential for desalinization is also implied.



Solar Cooker

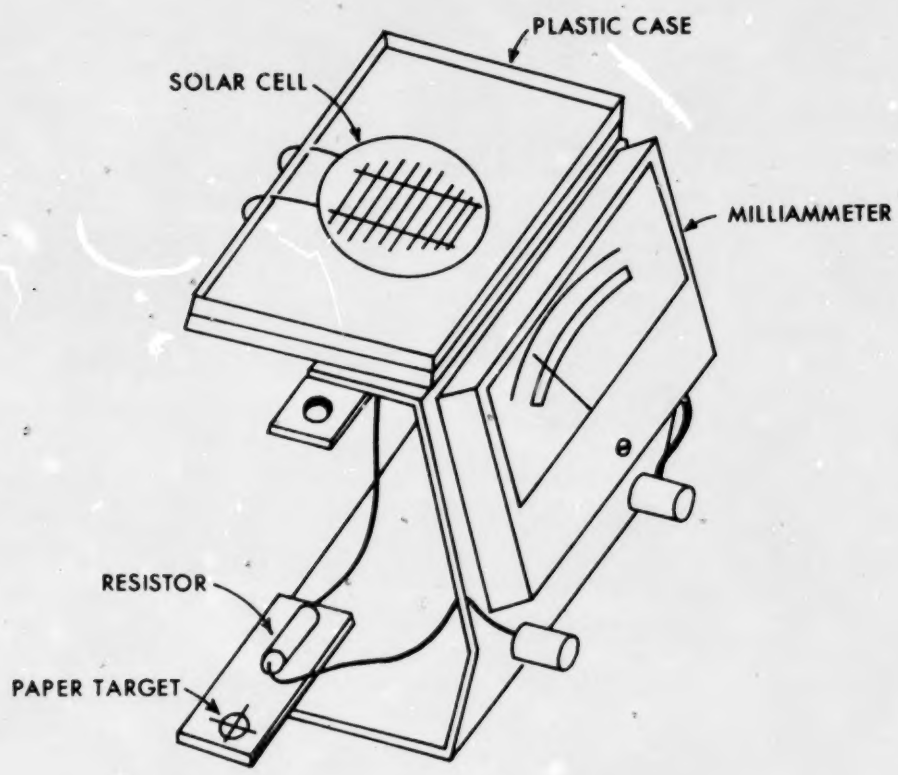
Few pieces of equipment show the power of the sun more dramatically than the cooker. The key element is the curved reflector which concentrates the solar rays upon the prospective meal.



SOLAR COOKER

SOLARIMETER

WHILE THE PHOTOELECTRIC EFFECT HAS BEEN KNOWN FOR ALMOST A CENTURY, THE USE OF THE SUN FOR ELECTRICAL GENERATION IS A FAIRLY RECENT APPLICATION. THIS SOLARIMETER PROVIDES A QUICK AND USEFUL METHOD FOR DETERMINING THE INTENSITY OF THE SUN'S RADIATION.



DIRECTIONS - A HOMEMADE SOLARIMETER

1. Drill two small holes (just large enough for thin insulated wire) in back edge of the top cover of the plastic case.

2. Tape plastic case to meter frame.

3. Drill 1/4" hole in sighting strip before cementing in place.

4. Solder one lead of resistor to the short piece of wire. Attach the other lead of resistor to wire (negative) from solar cell. Solder for permanent setup (or use screw and nut for easy disassembly of cell).

5. Solar Cell - Solder leads of thin stranded wire to cell. Attach lead from backside of cell to positive (red) terminal of D.C. milliammeter; attach lead from top side of cell to negative (black) terminal of milliammeter.

6. By merely disconnecting the leads from the solar cell to the meter, the meter may be used as a milliammeter.

7. Cement small strips of masonite (or wood) to inside top and bottom flange of meter frame. Let 2 cm. of ends of each overhang frame. Glue white paper with inked-on target pattern on bottom piece. These should be aligned so that a beam of light passing through the hole in the top piece strikes the target perpendicular to the plane of the solar cell.

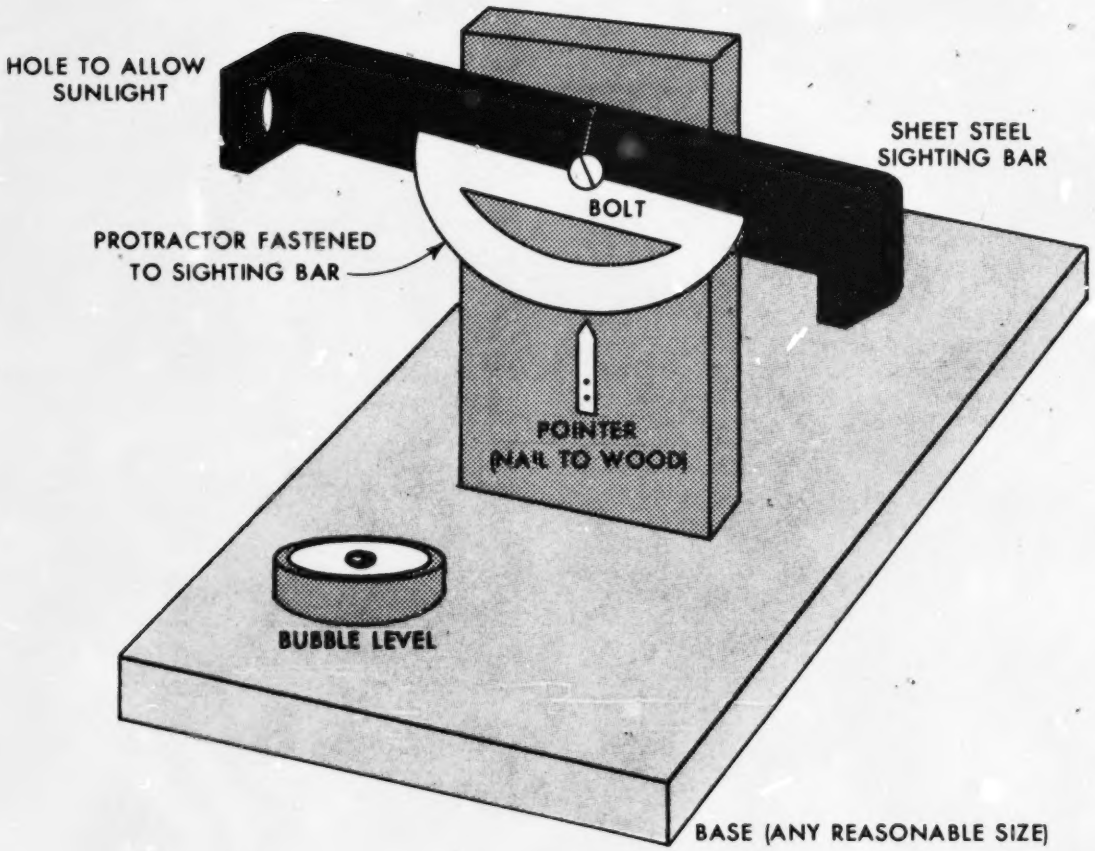
8. The exact size of the resistor will depend on the characteristics of meter and solar cell used. The purpose is to reduce the current output of the cell, under maximum energy conditions, to nearly full scale value of the meter. A rough approximation of the size of the resistor in ohms can be found by using the expression: $R = \frac{V_{sc}}{I_{sc} - I_{fs}}$ where V_{sc} = rated output voltage of cell, I_{sc} = rated current (amperes) of cell, and I_{fs} = full scale value (amperes) of milliammeter.

List of Materials:

D.C. milliammeter 3" scale - 150 M.A.
Solar cell 2 1/8" diameter, 400 M.A., .45 v
Resistor (See Item 8 above) 3 Ω , 1/2 watt carbon
2 pieces of k/2" masonite 2 cm x 7 cm
Stranded insulated wire (any small diameter)
Tape, Glue

Solar Clinometer

One critical factor in determining the orientation of a solar collector is the altitude of the sun. The solar clinometer is a simple device that will accurately measure this quantity.



Resources-References

SOLAR ENERGY PROJECT

DRAFT

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Award Winning Energy Education Activities. Department of Energy. (Available from Technical Information Center, Oak Ridge, Tennessee).

Careers in Energy Industries. Department of Energy. (Available from Technical Information Center, Oak Ridge, Tennessee).

*R *David & Cynthia Edney: Solar-Assisted Heat Pump*, Edward Moran. Popular Science, October 1977.

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*R *Energy From the Sea, Part II: Tapping the Reservoir of Solar Heat*, Arthur Fisher, Popular Science, June 1975

*R *Energy from Wood Wastes*, Paul Cheremisinoff, Environment, May 1977

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Exploring Earth Science, Walter A. Thurber and Robert E. Hilburn. (Boston: Allyn & Bacon, Inc.) 1970

*R *Five Solar Water Heaters You Can Build*, Edward Moran, Popular Science, May 1976

*R *Green Plants as Solar Energy Converters*, Lois R. Ember, Environmental Science and Technology, June 1976

*R *Green Plants Might Provide the Cheapest Energy of All*, Gene Bylinsky, Fortune, September 1976

*R *Ground Water Heat Pumps - Home Heating From Your Own Well*," Robert Gannon, Popular Science, February 1978

Heating Degree Days, Raymond Falconer. (Albany: State University at Albany, Atmospheric Sciences Research Center) Publication #432

Home Handyman, Popular Mechanics Illustrated Encyclopedia. (New York: Readers Institute of America) 1972

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*R-These articles are included in the "Reader" section of the Solar Energy Curriculum Document.

Intermediate Minimum Property Standards for Solar Heating and Domestic Hot Water Systems, Volume 5 (U.S. Department of Housing and Urban Development) 1977

Introduction to the Atmosphere, Herbert Riehl. (New York: McGraw-Hill) 1965

Job Inquiry Text-Earth Science, Sanford Eisolve, M. Stark and P. A. DiSantis (New York: Cambridge Book Co.) 1973

*R *John DesChenes: Corrugated-Plate Window Collector*, Edward Moran, Popular Science, January 1978

*R *Kilowatts from the Sky*, Peter Britton, The Lamp, Summer 1976.

*R *Not Out of the Woods*, C. E. Calef, Environment, September 1976

Notes From the Field: How Architects and Their Consultants Approach Solar Design, Margaret F. Gaskie, Architectural Record, Mid-August 1977

Other Homes and Garbage: Designs for Self-Sufficient Living, J. Lackie, G. Whitehouse and L. Young. (San Francisco: Sierra Club Books) 1975

Measure the Sun's Energy With a Solar Radiometer, Warren Jachem, Popular Electronics, December 1976

*R *Photosynthetic Solar Energy: Rediscovering Biomass Fuels*, Allen Hammond, Science, August 1977

Photovoltaic Solar Energy Conversion, Martin Wolf, Bulletin of Atomic Scientists, April 1976

*R *Power From the Sea*, Mark Swann, Environment, May 1978

*R *Power With Heliostats*, A. Hildebrandt and L. Vant-Hull, Science, September 1977

Producing Your Own Power, Carol Hupping Stoner, Ed. (Pennsylvania: Rodale Press, Inc.) 1974

Raise High The Solar Greenhouse, John Neary, Horticulture, September 1976

School Subjects and Jobs, John H. Brochard, (Chicago: Science Research Associates, Inc.) 1971

*R *Soft and Hard Energy*, Nicholas Wade, The New Republic, February 1978

Solar Energy, William W. Eaton. Department of Energy. (Available from Oak Ridge Technical Information Center) 1976

Solar Energy: Potential Powerhouse for Jobs, Tom McCallion, Work Life, August 1976. (Reprinted in Social Issues Resources Series, Energy, Volume 2, Article #33).

Solar Energy Concepts in the Teaching of Chemistry, Joseph S. Cantrell, Journal of Chemical Education, January 1978

Solar Energy Experiments, Thomas Norton, (Emmaus, Pennsylvania: Rodale Press) 1977

Solar Energy Handbook, 1978 Popular Science (New York: Times Mirror Magazines) 1978

*R *Solar Energy Research: Making Solar After the Nuclear Model*, A. Hammond, and W. Metz, Science, July 1977

*R *Solar Energy: Wave of the Future*, D. Levy, Journal of Property Management, July/August 1976

*R *Solar Thermal Energy: Bringing the Pieces Together*, W. Metz, Science, August 1977

Student Investigations in Solar Heating Systems, The Physics Teacher, May 1978

The Dawn of an Industry, Nation's Business, September 1974 (Reprinted in Social Issues Resources Series, Energy, Volume 1, Article #79).

*R *The Flaming God*, Isaac Asimov, Saturday Review, October 1976

The Flying Circus of Physics, Jearl Walker. (New York: Wiley) 1977

The Life History of a Star, J. Myron Atkin and Stanley Watt, Jr. (New York: Harper & Row) University of Illinois Astronomy Program - Book 5 1969

The Solar Home Book, Bruce Anderson, (New Hampshire: Chesshire Books) 1976

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The World of Matter-Energy, Paul F. Brandwein, Alfred D. Beck, Violet Strahler, Leland G. Hollingworth and Matthew J. Brennan. (New York: Harcourt, Brace &

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What Size Solar Heating System is Economical for a House?, Donald Watson, and Fred Brober, Architectural Record, March 1977.

Workbench-Energy Answers, Tom Dean, Modern Handcraft, September-October 1977

Your Energy Efficient House, A. Adams. (Vermont: Garden Way Publishing Company) 1975

REFERENCES & RESOURCES

RESOURCES

Copies of the following materials, prepared by the National Science Teachers Association, are available from:

Department of Energy
Technical Information Center
P.O. Box 62
Oak Ridge, Tennessee 37830

Factsheets on Alternate Energy Sources:

1. *Fuels From Plants, Bioconversion*
2. *Fuels From Wastes, Bioconversion*
3. *Wind Power*
4. *Electricity From the Sun I, Solar Photovoltaic Energy*
5. *Electricity from the Sun II, Solar Thermal Energy Conversion*
6. *Solar Sea Power, Ocean Thermal Energy Conversion*
7. *Solar Heating and Cooling*
8. *Geothermal Energy*
9. *Energy Conservation, Homes and Buildings*
10. *Energy Conservation, Industry*
11. *Energy Conservation, Transportation*
12. *Conventional Reactors*
13. *Breeder Reactors*
14. *Nuclear Fusion*
15. *New Fuels From Coal*
16. *Energy Storage, Technology*
17. *Alternative Energy Sources, Environmental Impacts*
18. *Alternative Energy Sources, A Glossary of Terms*
19. *Alternative Energy Sources, A Bibliography*

Interdisciplinary Student/Teacher Materials in Energy, the Environment and The Economy

The Energy We Use (Grade 1)
Community Workers and the Energy They Use (Grade 2)
Energy, Engines, and the Industrial Revolution (Grades 8-9)
Transportation and the City (Grades 8-9)
How a Bill Becomes a Law to Conserve Energy (Grades 9, 11, 12)
Agriculture, Energy and Society (Grades 10, 11 12)
Energy and Transportation (Grade 3)
Networks: How Energy Links People, Goods and Services (Grades 4-5)
Two Energy Gulfs (Grades 6-7)
The New Westward Movement (Grade 11)
U.S. Energy Policy - Which Direction? (Grades 11-12)
An Energy History of the United States (Grades 8-9)
Energy in the Global Marketplace (Grades 9, 10, 11)
Bringing Energy to the People: Ghana and the U.S. (Grades 6-7)
Mathematics in Energy (Grades 7-8)

Curriculum Materials

Energy Conservation in the Home: An Energy Education/Conservation Curriculum Guide for Home Economics Teachers

Award Winning Energy Education Activities for Elementary and High School Teachers

Science Activities in Energy

RESOURCES, Continued

Energy and Education (A bi-monthly newsletter)
National Science Teachers Association
1724 Connecticut Ave., N.W.
Washington, D. C. 20036

Energy Insider (Department of Energy Newsletter)
Energy Insider
U. S. Department of Energy
Washington, D. C.

Information on Energy Alternatives
Public Interest Research Group
P.O. Box 19312
Washington, D.C. 20036

Reading List for Solar Energy & Do-It Yourself Projects for Solar Energy
National Solar Heating and Cooling Information Center
P.O. Box 1607
Rockville, Maryland 20850

Solar Energy Books (Catalog including annotated list of energy books)
National Solar Energy Education Campaign
10762 Tucker Street
Beltsville, Maryland 20705

Solar Update (Guide to information sources in solar energy)
Environment Information Center
124 E. 39th St.
New York, New York 10016

The Energy Challenge (An Activity Master Program)
The Energy Challenge
Box 14306
Dayton, Ohio 45414

Note: Publishers of the following periodicals should be contacted directly for subscription rates.

Solar Age - Contains articles on solar energy applications. Monthly.
Solar Vision, Inc.
Church Hill
Harrisville, New Hampshire 03450

Solar Energy - Scientific and engineering papers on all aspects of solar energy. Bimonthly.
Pergamon Press, Inc.
Maxwell House
Fairview Park
Elmsford, New York 10523

RESOURCES, Continued

Solar Energy Digest - Summaries of solar energy developments, research and publications. Monthly.
W. B. Edmondson
P.O. Box 17776
San Diego, California 92117

Solar Energy Intelligence Report - Covers the Washington beat in solar energy. Bi-weekly.
Business Publishers, Inc.
8435 N. Stemmons Freeway
Suite 880
Silver Springs, Maryland 20910

Solar Utilization News - Solar energy developments by region; includes periodicals and meetings. Monthly.
Alternate Energy Institute
P.O. Box 3100
Estes Park, Colorado 80517

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